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EDGEWOOD ARSENAL CONTRACTOR REPORT

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EXPLOSIVE CLASSIFICATION TESTING OF PYROTECHNIC END ITEM BROWN BESS CARTRIDGES

By

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September 1976

NASA NATIONAL SPACE TECHNOLOGY LABORATORIES

COMPUTER SCIENCES CORPORATION

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- Detonation Test "A"
- Detonation Test "B"
- Detonation Test "C"

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*:
This document contains the results of tests performed on the Brown Bess Cartridges in a 60 rd. cartridge container in accordance with U.S. Army Technical Bulletin 700-2, Change 1, Chapter 4 with the following results: Detonation Test "A" - No propagation within the single container; Detonation Test "B" - Not required; and External Heat Test "C" - No explosion.

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PREFACE

The work described in this report was authorized under US Army MIPR BT005 and Technical Work Request (TWR) EA 3T01. It was performed at the NASA National Space Technology Laboratories (NSTL) for the Edgewood Arsenal Resident Laboratory (EARL) and NASA-NSTL by the Computer Sciences Corporation under Contract NAS 13-50 This work was completed 9 September 1976.

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EXPLOSIVE CLASSIFICATION TESTING OF PYROTECHNIC END ITEM

BROWN BESS CARTRIDGES

1.0 INTRODUCTION

1.1 Objective. The objective of this study was to provide results of the Brown Bess Cardridges tendency to propagate within a single shipping container, between shipping containers, and the reaction resulting from burning the munition in an intense fire. The individual tests specified in TB 700-2, Change 1, Chapter 4 are:

- Detonation Test "A"
- Detonation Test "B"
- External Heat Test "C"

1.2 Authority. The work described in this report was authorized by TWR EA-3T01.

1.3 Background. Evaluation of pyrotechnic end item munitions is currently accomplished through test data obtained from specific tests performed in accordance with Chapter 4, TB 700-2. Chapter 4 provides test requirements for pyrotechnic end item munitions manufactured, packaged, and ready for field use.

The results of tests may be utilized by cognizant Department of Defense/Department of Transportation agencies to assign hazards classification and compatibility for transportation and storage of end item munitions.

2.0 TECHNICAL APPROACH

2.1 Background. The Brown Bess is a muzzle loaded musket dating from revolutionary times. It is displayed and fired during demonstrations and ceremonies by the "Commander-In-Chief Guards" of the 3rd United States Infantry (The Old Guard), Fort Meyer, Virginia. Its operation required black powder cartirdges. A cartridge is made of standard bond paper rolled into a 1.3cm (.50 in.) diameter cylinder 11.4 cm (4.50 in.) long, the cartridge wall being four ply. One end is crimped and fastened with cellophane tape. The cartridge is loaded with 9.72 grams (150 gr) of FFF_g Black Powder (Index 13-17). The top of the cartridge is crimped by rolling the paper three times toward the longitudinal center of the cylinder and fastening it with cellophane tape.

Sixty Brown Bess Cartridges are placed in a container as shown in Figure 1 for transportation. Salient container features are shown in Figure 2. The 60rd cartridge container was designed and developed at NSTL for the specific purpose of rendering the cartridges "incapable of functioning en masse as a result of the functioning of any single cartridge in the container or as a result of exposure to external flame." [Ref.: 49CFR 173.100 b (3)]. The container was additionally required to prohibit a massive fire hazard.

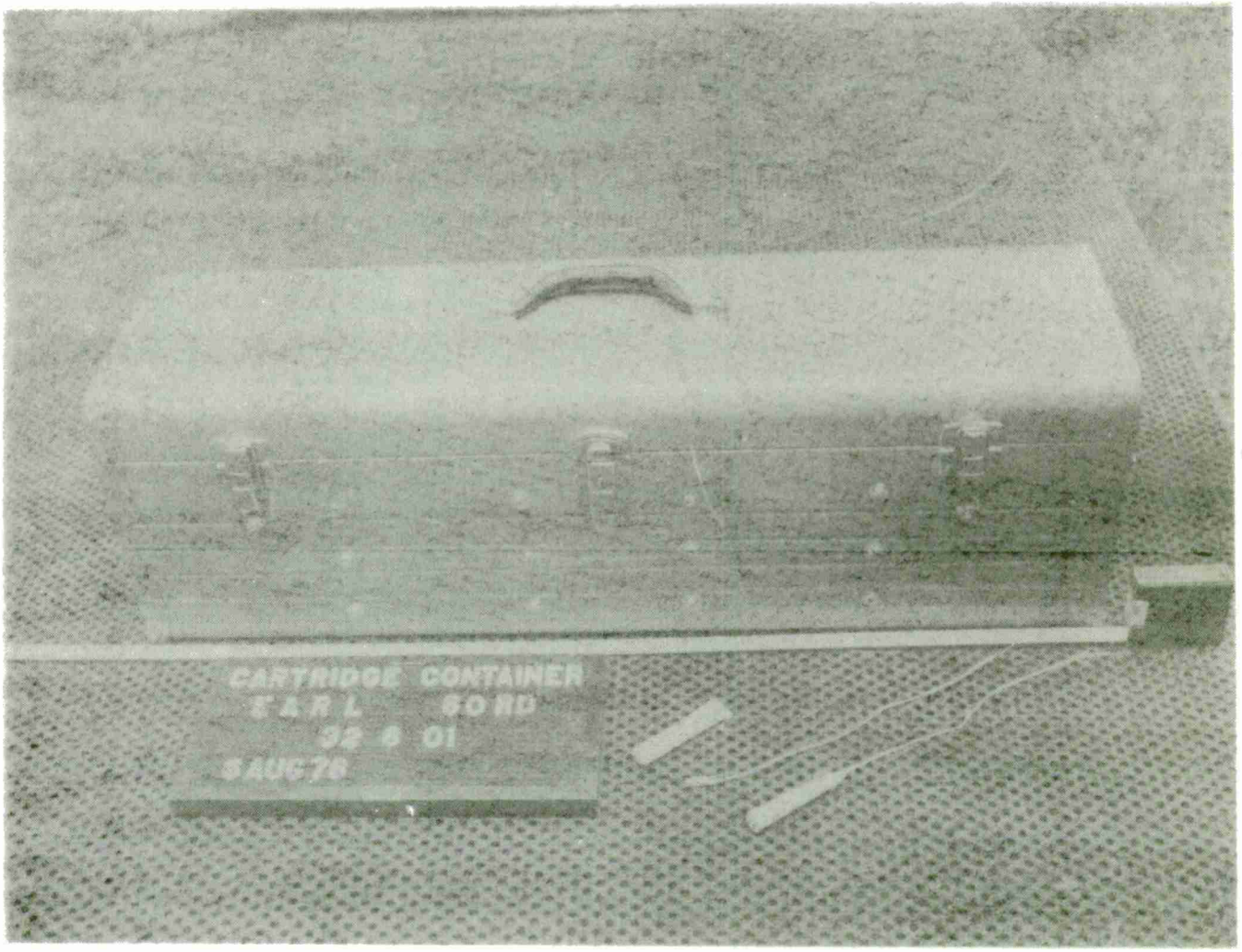
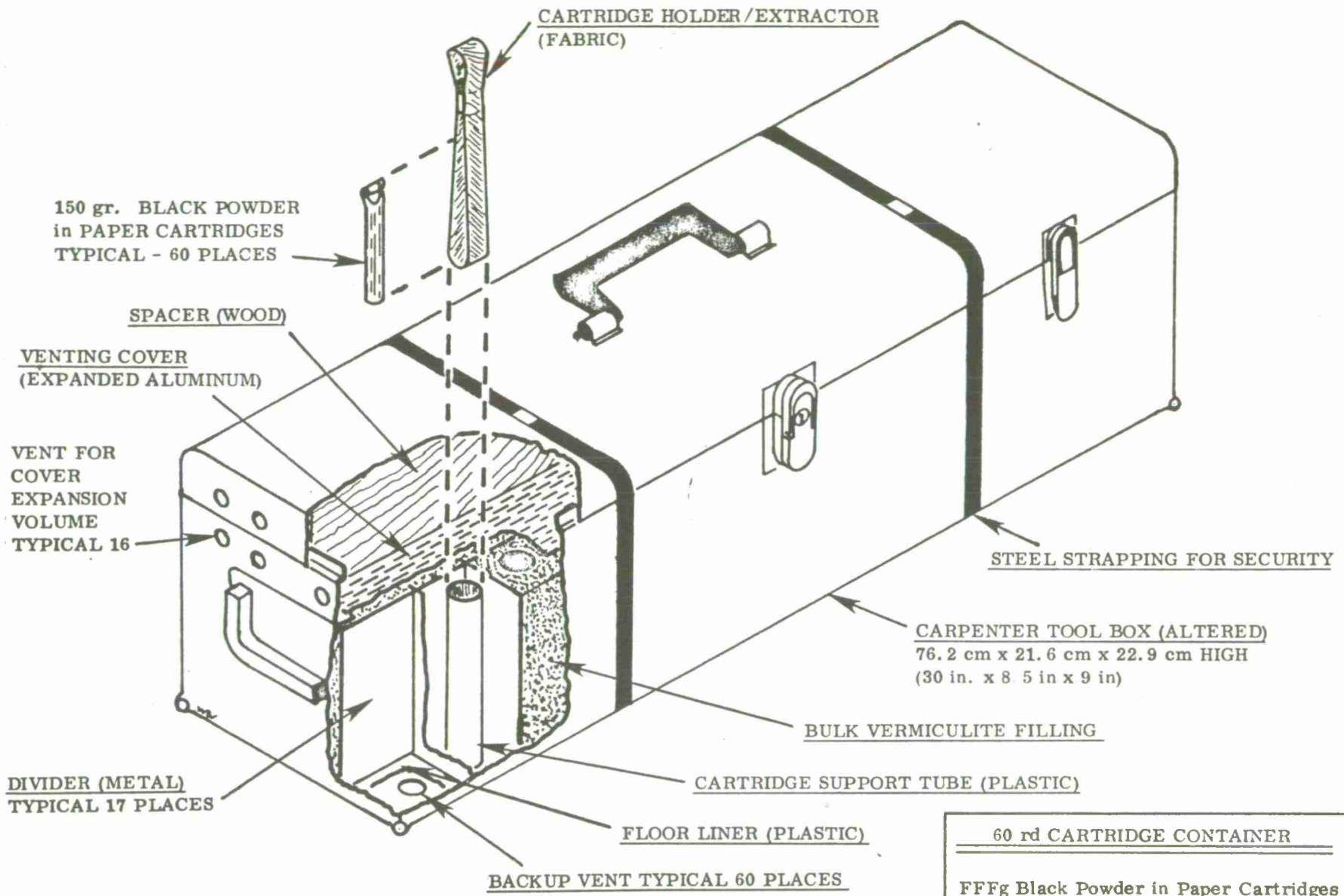


Figure 1. Overall View of Brown Bess Cartridge Container With Cartridge, Matchhead Igniter and Primed Round in Foreground



60 rd CARTRIDGE CONTAINER

FFFg Black Powder in Paper Cartridges for Firing in Brown Bess Muskets

.58 kg (1.29 lb) Net Powder Weight
17.57 kg (38.73 lb) ..... Gross Weight

Figure 2 Container Arrangement

2.2 End Item Munition Tests. Detonation Test "A" was conducted with the Brown Bess Cartridges packaged in the 60 round container. A centrally located cartridge was primed with an electric matchhead igniter.

The test was conducted five times to demonstrate:

- No propagation between donor and acceptor rounds
- No significant airblast
- No container rupture or fragment dispersion

Ordinarily, Detonation Test "B" is required when Detonation Test "A" results in propagation between items or container rupture. In the particular case of the Brown Bess cartridge, satisfactory completion of the Detonation Test "A" series precludes the conduct of the "B" test.

External Heat Test "C" is intended to simulate a condition wherein packaged end items are completely enveloped in a severe fire. The container was placed in the center of a crib 1.2 m (48 in.) square x 1.1n (43 in.) high. The interior of the crib was filled with scrap lumber and doused with 2087. (55 gal.) of diesel fuel. The fire was ignited on opposite sides of the crib base by two electrical matchhead igniters to which 10 grams of UTC 3001 propellant was attached.

External Heat Test "C" was conducted to demonstrate:

- No explosive mass reaction of the cartridges and attendant airblast
- No container rupture or fragment dispersion

2.3 Instrumentation. Each Detonation Test "A" was photographed in color at 24 frames per second; a bare round was photographed at the 50mm frame rate for demonstration only. The External Heat Test "C" was photographed in color at 6.28 frames per second. Black and white photographs are included in Appendix B to this Report. Airblast instrumentation was not deployed because the requirements for no container rupture were deemed to be adequate to demonstrate the absence of significant overpressures of 3.4kPa (.5psi) at 4.75m (15.6 ft)

3.0 RESULTS

3.1 Detonation Test "A". The 60 round container of Brown Bess cartridges was subjected to the End Item Detonation Test "A" five times. In each test there was no propagation to another cartridge in the container, significant airblast, container rupture of fragment dispersion. The only outward indications of donor functioning were an audible report and a puff of smoke. There was no motion picture coverage of the second test (32-6-01B) because of a camera malfunction.

3.2 Detonation Test "B". Not required. (See paragraphs 2.2 and 3.1).

3.3 External Heat Test "C". The 60 round container of Brown Bess Cartridges was subjected to an intense wood and diesel fuelled fire as described in paragraph 2.2 lasting approximately one hour. There was no explosive mass reaction of the cartridges, container rupture or fragment dispersion. The first observed found function was at 12.9 min. after ignition and the last at 55.0 min. The mean time to function for all rounds was 33.8 min. with a standard deviation of 9.5 min. (These data compare very favorably with a previous experimental 24 round container which functioned its rounds between 10.8 min. and 19.0 min. with a mean time to function at 14.9, 2.9 min.)

3.4 Weight. The prototype 60 round cartridge container was weighed as follows:

Empty Box	14.7 kg	(32.5 lb.)
Vermiculite	2.2	(4.8)
Tare Weight =	16.9	(36.3)
Cartridges	.7	(1.5)
Gross Weight =	17.6 kg	(38.7 lb.)

(This weight of .29 kg (.65 lb.) per round compares favorably with the experimental 24 round container mentioned above that weighed 10.0 kg (22.1 lb.) for .42 kg (.92 lb.) per round).

4.0 CONCLUSIONS

The results of these tests on the Brown Bess Cartridges in the 60 round container indicate that:

- No propagation occurred within the container when a single round was functioned.
- There was no significant airblast during any of the tests.
- There was no container rupture or fragment dispersion during any of the tests.
- There was no mass reaction of the cartridges during any of the tests.
- The External Heat Test "C" pyre with the loaded 60 round container is no more hazardous to its surroundings than it would be without the container.

5.0 RECOMMENDATIONS

It is recommended that the reaction suppression techniques developed for this application be subjected to further study and development and that additional applications be considered.

APPENDIX A

DATA SHEETS

Test Type: Standard TB 700-2 Detonation A Test	Date: 6 Aug 76
Sponsoring Agent: Edgewood Arsenal Resident Laboratory for 3d United States Infantry (The Old Guard)	Test Number: 32-6-01A thru 32-6-01E
Contract Number: NSTL TWR EA 3T01 MIPR BT005	Designation: Brown Bess Cartridge 150 grain FFFg Black Powder
Specification: 60 rd = 583 gm (1.29 lb) Total EARL 60 rd Cartridge Container Prototype	Drawing Number: None
Lot Number: N/A	Manufacture Date: 5 Aug 76

METEOROLOGICAL DATA

Temperature: 32 deg C (90 deg F)	Humidity: 63 %	Barometric Pressure: 1014 mb(29.94 in Hg)
Wind Direction: 245	Wind Velocity: 8 km/hr (5 mph)	

TEST SET UP

Priming: Electric Matchhead Igniter	Location of ~~XXXXXXX~~ Donor: A: row 3, col. 8 B: row 3, col. 9 C: row 2, col.10 D: row 2, col. 8 E: row 3, col. 9
Booster: None	Confinement: N/A

TEST RESULTS

Detonation Test A	Detonation Test B NOT REQUIRED	External Heat Test "C"
Propagation	Propagation	Explosion
Yes 0 No 5	Yes ____ No ____	Yes ____ No ____
Attachments: Photo X; Map N/A; Blast Press. N/A	Attachments: Photo ____; Map ____; Blast Press. ____	Attachments: Photo ____; Map ____; Blast Press. ____
Test Conductor: Steve Fuentes	Project Engineer: T. Robledo	Test Dept. Head: R. M. Kogler

Assigned Classification

ICC Forbidden	
ICC Restricted *	
ICC Class A	
ICC Class B	

Signature

Title

Organization

*Shipping instructions are to be obtained from ICC Para. 3-13A(2)

Test Type: Standard TB 700-2 External Heat Test "C"	Date: 9 Aug 76
Sponsoring Agent: Edgewood Arsenal Resident Laboratory for 3d United States Infantry (The Old Guard)	Test Number: 33-6-01
Contract Number: NSTL TWR EA 3To1 MIPR BT005	Designation: Brown Bess Cartridge 150 grain FFFg Black Powder
Specification: 60 rd = 583 gm (1.29 lb) Total EARL 60 rd Cartridge Container Prototype	Drawing Number: None
Lot Number: N/A	Manufacture Date: 5 Aug 76

METEOROLOGICAL DATA

Temperature: 30 deg C (90 deg F)	Humidity: 42 %	Barometric Pressure: 1012 mb (29.90 in Hg)
Wind Direction: 330	Wind Velocity: 10 km/hr (6 mph)	

TEST SET UP

Priming: Electric Matchhead Igniter	Location of Acceptor: In center of pyre
Booster: 208 l (55 gal) Diesel Fuel	Confinement: N/A

TEST RESULTS

Detonation Test A	Detonation Test B	External Heat Test "C"
Propagation: Yes ___ No ___	Propagation: Yes ___ No ___	Explosion: Yes ___ No X
Attachments: Photo ___ Map ___ Blast Press. ___	Attachments: Photo ___ Map ___ Blast Press. ___	Attachments: Photo X Map N/A Blast Press. N/A
Test Conductor: Steve Fuente	Project Engineer: R. Wilson	Test Dept. Head: M. Kogler

Assigned Classification

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ICC Class B	

Signature

Title

Organization

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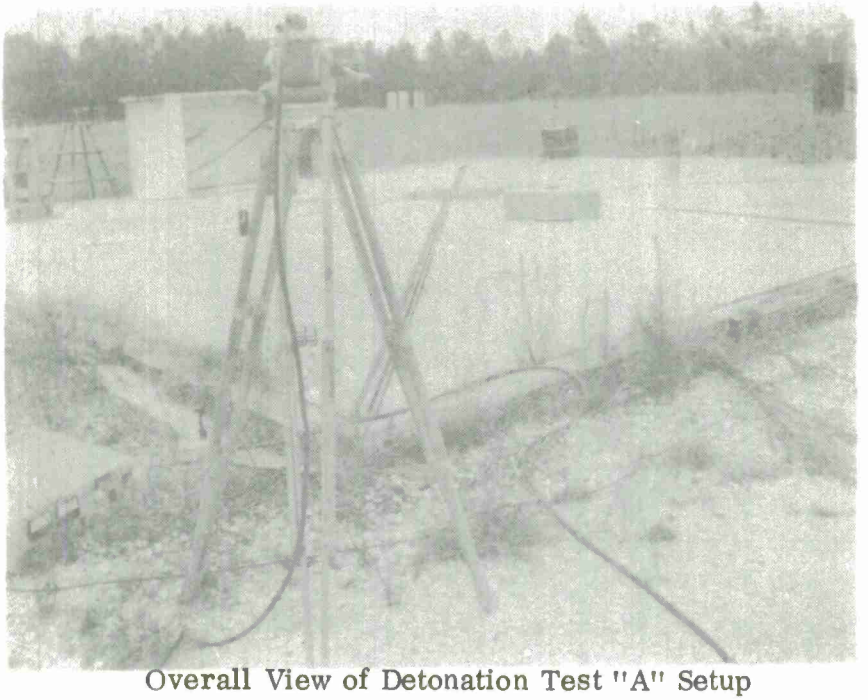
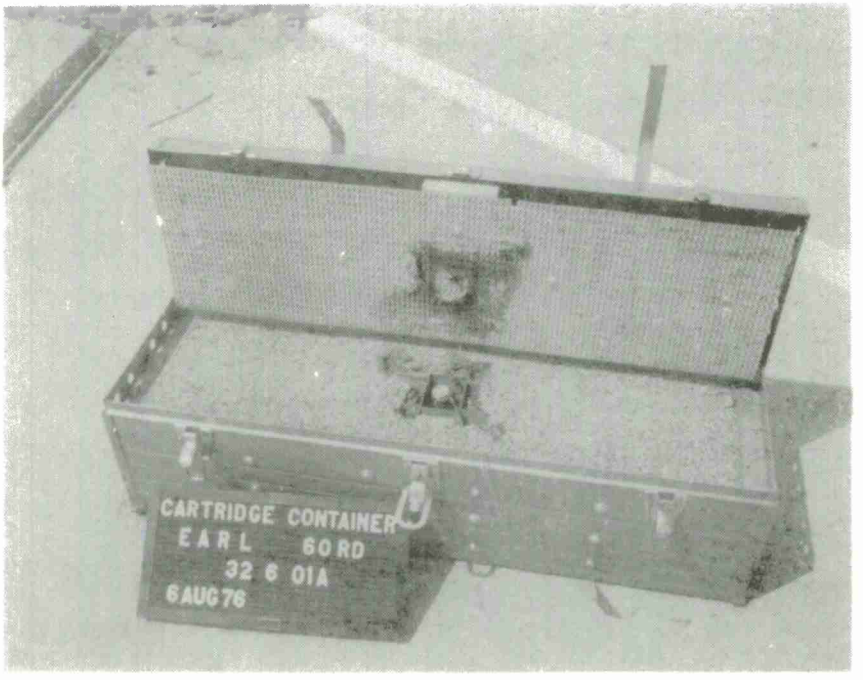
APPENDIX A

APPENDIX B

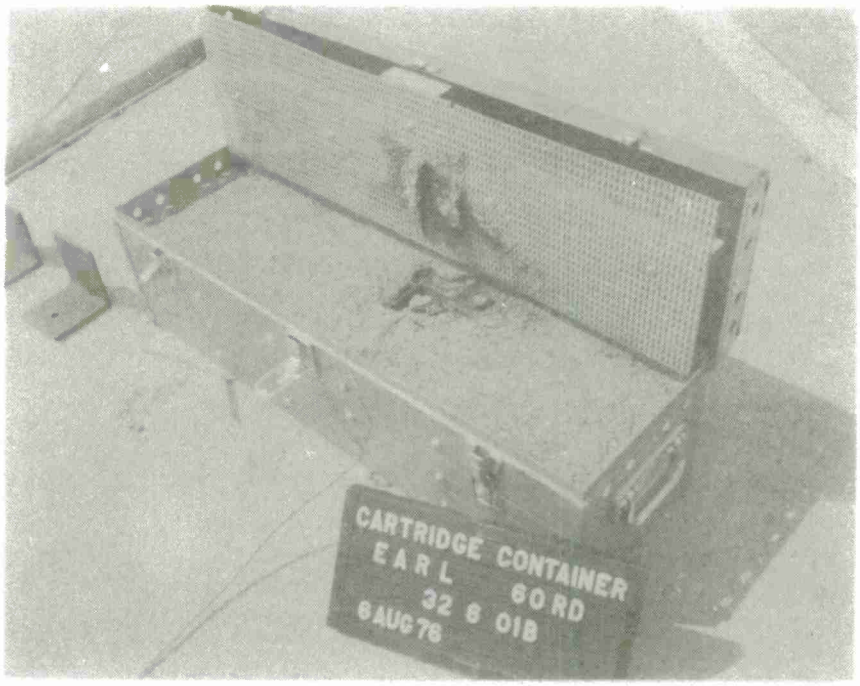
SELECTED PHOTOGRAPHS



Overall View of Detonation Test "A" Setup



Interior View After First "A" Test

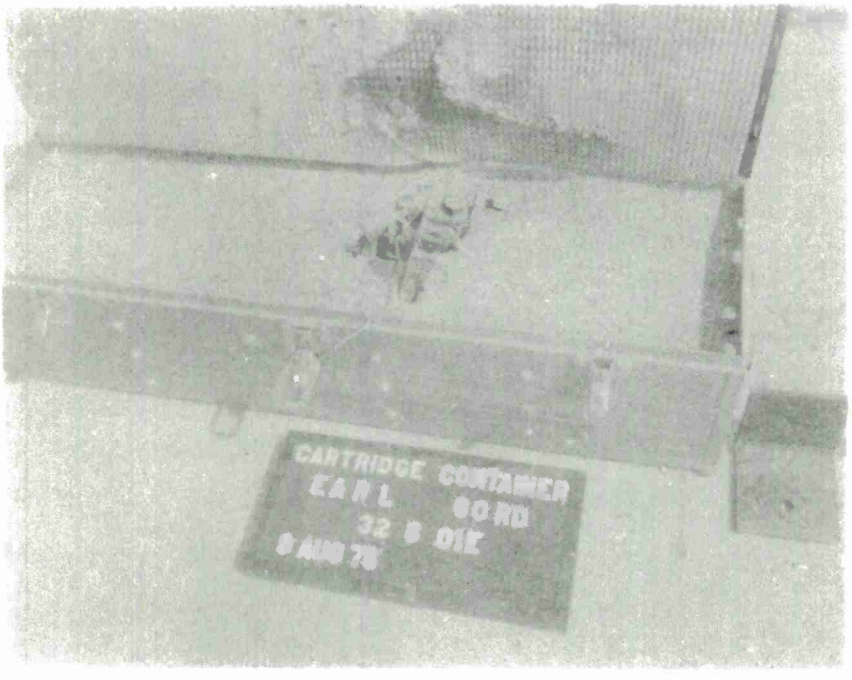


Interior View After Second "A" Test

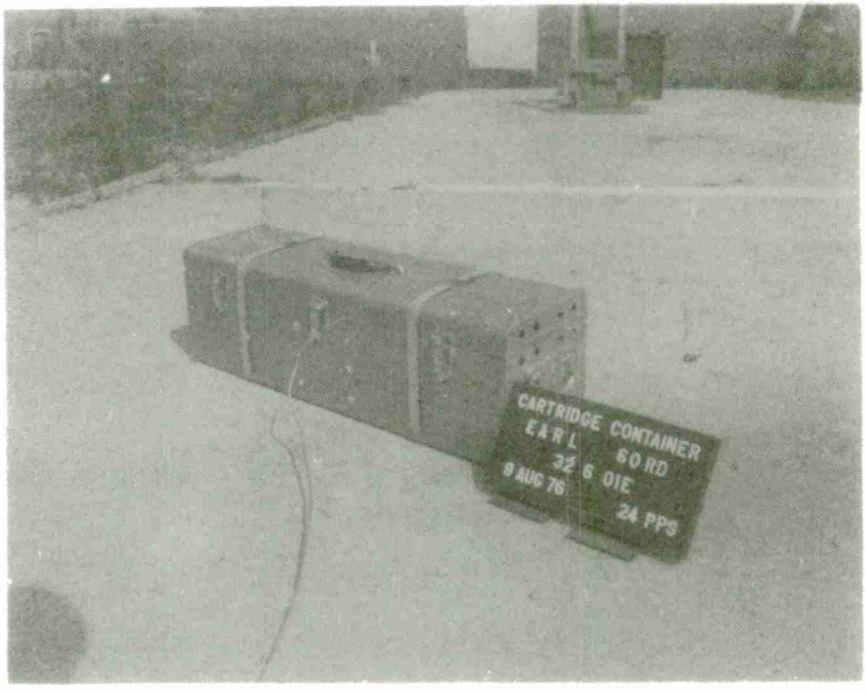
Interior View After Third "A" Test

APPENDIX B

Interior View After Fourth "A" Test

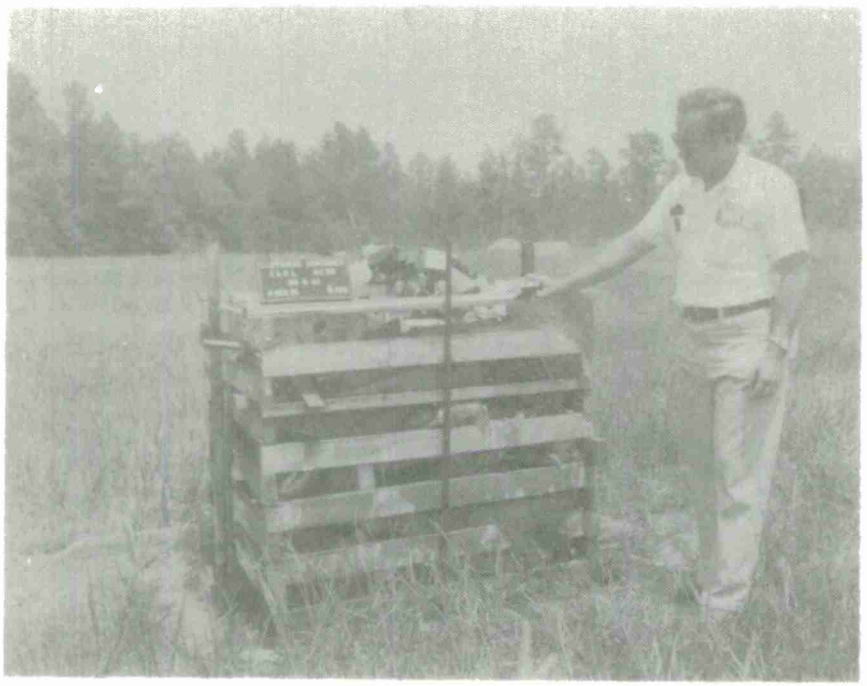


Interior View After Fifth "A" Test

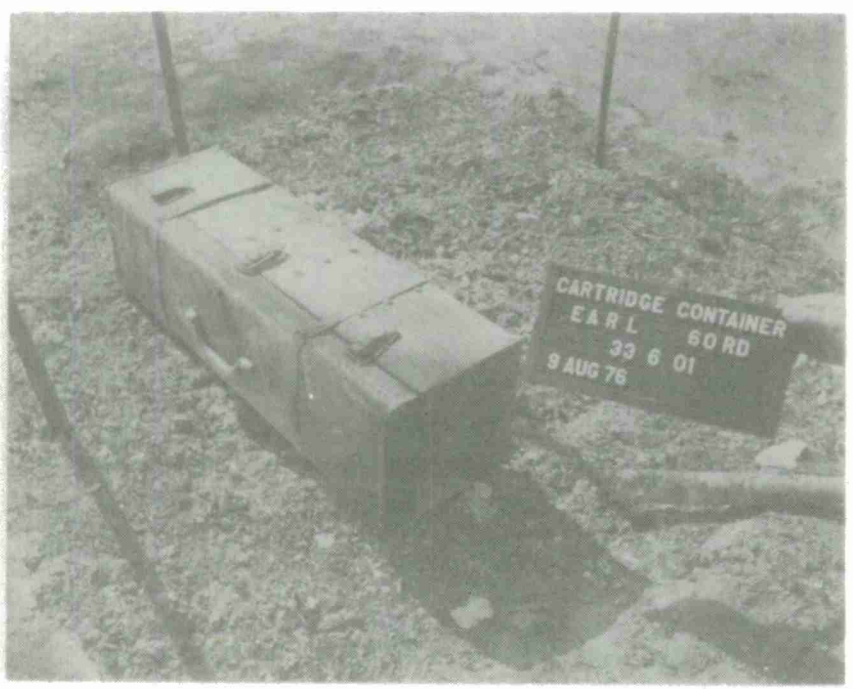


Exterior View After Fifth "A" Test
(Note that all five tests were conducted in the same container and that it appears to be undamaged)

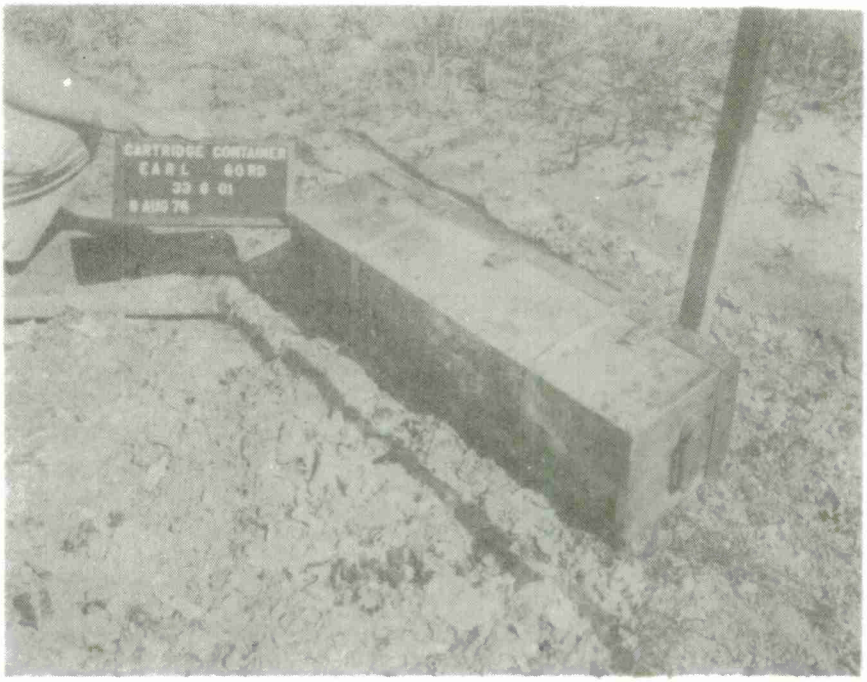
Bottom View After Fifth "A" Test
(Note that no bottom holes have blown out)



External Heat Test "C" Pyre Before Test



Post External Heat Test "C"
(Note the virtually undamaged conditions of the container in this and succeeding photographs)

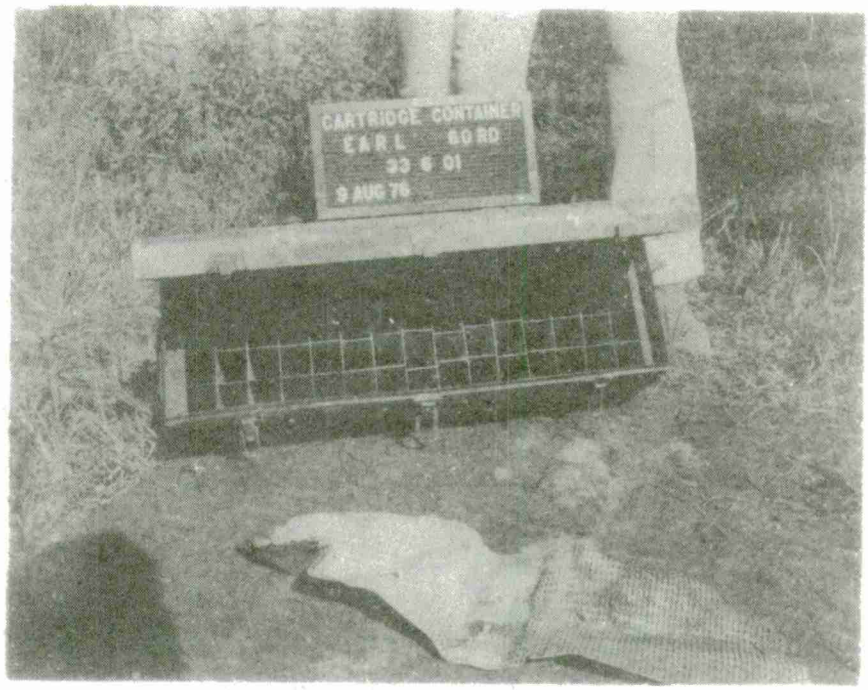


Post External Heat Test "C"

Post External Heat Test "C"

Post External Heat Test "C"
Immediately After Opening Container

Post External Heat Test "C"
Interior View With Venting Cover in Foreground



Interior View With Vermiculite
Removed to Show Condition of Dividers

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